NON-PUBLIC?: N
ACCESSION #: 8801200424

LICENSEE EVENT REPORT (LER)

FACILITY NAME: Waterford Steam Electric Station Unit 3 PAGE: 1 of 9

DOCKET NUMBER: 05000382

TITLE: Reactor Trip Due to a Failed Solenoid Valve During Main Steam Isolation Valve Testing
EVENT DATE: 12/11/87 LER #: 87-028-00 REPORT DATE: 01/11/88

OPERATING MODE: 1 POWER LEVEL: 90%

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:
NAME: D.W. Vinci, Maintenance Superintendent TELEPHONE #: 504-464-3138

COMPONENT FAILURE DESCRIPTION:
CAUSE: X SYSTEM: SB COMPONENT: FSV MANUFACTURER: F167
REPORTABLE TO NPRDS: Y

SUPPLEMENTAL REPORT EXPECTED: No

ABSTRACT: On December 11, 1987, Waterford Steam Electric Station Unit 3 was operating at 90% power when a reactor trip occurred due to the inadvertent shutting of a Main Steam Isolation Valve (MSIV). At 0754 hours, with the Auxiliary Feedwater Pump tagged out and the high pressure steam supply to Main Feedwater Pump (MFWP) Turbine A isolated, MSIV testing was in progress when MSIV #2 went partially shut due to a failed solenoid valve. This resulted in a Core Protection Calculator trip due to a large difference in reactor cold leg temperatures. The MSIV closure also caused a Steam Generator (SG) secondary side pressure relief valve to lift. Both MFWP's tripped after the reactor trip, but the Emergency Feedwater system functioned properly throughout the event to maintain SG levels.

The MSIV went partially shut because a solenoid valve (SV) stuck open during testing allowing both hydraulic system dump valves to be open simultaneously and drain the hydraulic fluid from the MSIV actuator. The SV was replaced and the MSIV tested successfully prior to restarting the plant. The SV has been returned to the manufacturer for analysis and recommendations. Since all protective features functioned as designed, there was no threat to the

health and safety of the public or plant personnel.

(End of Abstract)

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On December 11, 1987, Waterford Steam Electric Station Unit 3 was operating at 90% power and surveillance procedure OP-903-032 "Quarterly ISI Valve Tests" section 8.1 "Main Steam" was in progress. The Auxiliary Feedwater (AFW) Pump (EIIS Identifier BA-P) had been tagged out for routine maintenance at 0700 hours that morning. The AFW system (EIIS Identifier BA) is not safety related and therefore is not required to be maintained operable.

In normal operation, supply steam for the Main Feedwater (MFW) Pump Turbines (EIIS Identifier SJ-TRB) is reheat steam from the Moisture Separator Reheaters (MSR) (EIIS Identifier SB-RHTR) with Main Steam (EIIS Identifier SB) in standby as a backup. On October 12, 1987 the MFW Pump Turbine A was manually isolated from the main steam supply header because the High Pressure Governor Valve (EIIS Identifier SJ-SCV) was leaking steam by in pulses. This caused the Low Pressure Governor Valve (SB-SCV) and the MFW Pump (EIIS Identifier SJ-P) to cycle. To temporarily corrected this, the high pressure governor valve was isolated from main steam by closing a manual upstream valve. With a Reactor (EIIS Identifier AB-RCT) and Main Turbine (EIIS Identifier TA-TRB) trip, the steam supply to the MSR is isolated; therefore no steam will be fed to MFW Pump Turbine A. As a result, MFW Pump A will coast down in speed and stop supplying feedwater shortly after the trip.

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Steam drains from the MFW pumps' turbine casings are collected in MFW Casing Drain Tanks (CDT) (EIIS Identifier SM-TK) and vacuum dragged to the Main Condenser (EIIS Identifier SG-COND). Since the MFW pumps are on the same level as the main condenser, the CDT tank levels are approximately the same as main condenser hotwell level. High levels in these tanks may resut in water damage to a MFW pump turbine so high level trips are provided. These trips are very sensitive to hotwell pressure and level pertubations. If the reactor and main turbine were to trip, causing the Steam Bypass Control System (SBCS) (EIIS Identifier JI-FCV) to open and the main feedwater regulating valves to shut, excess condensate could accumulate in the main condenser hotwell. An increase in main condenser hotwell level will raise CDT tank levels and may result in tripping the MFW pumps. If this happens the MFW pumps cannot be restarted until CDT tank levels are reduced below the trip setpoints. This usually requires draining excess condensate from the hotwell.

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At 0754 hours test Train A of Main Steam Isolation Valve (MSIV) (EIIS Identifier SB-ISV) #2 had just been tested. The test appeared to have been completed properly because the valve stroked approximately 10% closed and then returned to the fully open position as it should have. The MSIV then closed rapidly to an intermediate position which caused a pressure increase in #2 Steam Generator (SG) (EIIS Identifier AB-SG) to approximately 1065 psig, causing one of that steam generator's secondary pressure relief safety valves (EIIS Identifier SB-RV) to lift. The pressure increase in #2 SG caused level to shrink to the Emergency Feedwater Actuation Signal (EFAS) (EIIS Identifier JE) setpoint, which started the Emergency Feedwater (EFW) System (EIIS Identifier BA) in standby. The MSIV reopened automatically after it went to an intermediate position due to a limit switch which operates to close the MSIV actuator hydraulic fluid dump valves if the MSIV goes greater than 10% shut during testing. the reduction in steam load on #2 SG and increase in load on #1 SG resulted in an increase in the Reactor Coolant system (EIIS Identifier AB) Cold Leg #2 Temperature and a decrease in Cold Let #1 and #2 Cold Leg Temperatures reached the Asymmetrical Steam Generator Trip Setpoint, and Departure from Nucleate Boiling Ratio and Local Power Density trips were generated on Core Protection Calculators. Operations personnel entered procedure OP-902-000 "Emergency Entry Procedure".

The Steam Bypass Control System and MFW System operated normally immediately after the trip to control steam generator pressure and levels. At 0757, MFW Pump (EIIS Identifier SJ-P) B tripped due to high Casing Drain Tank level and at 0758 procedure OP-902-001, "Uncomplicated Reactor Trip Recovery" was entered. When the main turbine tripped immediately after the reactor trip, the only steam supply for MFW Pump Trubine A was lost. With MFW Pump B tripped and steam isolated from the MFW Pump Turbine A most main feedwater flow was lost. Condenser hotwell level continued to increase due to operation of the SBCS, preventing vacuum draining of the MFW Pump CDT, and at 0803 MFW Pump A also tripped due to high CDT level. With SG levels decreasing, EFW flow was manually initiated at 0809 hours and at approximately 0813 hours the EFW system operated automatically to further increase the feed rate. The AFW pump was returned to service and started at 0826. As the AFW system is not a required safety system it was not necessary to be available, but restoring and using it expedited returning both SG levels to normal range and removing excess condensate from the main condenser.

After the plant was placed in a normal hot standby condition, troubleshooting was performed on #2 MSIV. It was determined that a solenoid valve (EIIS Identifier SB-FSV) manufactured by Fluid Control Inc. Model No. 7WXP4774-600K865 had stuck open. Refer to figure 1 during the following

explanation. The first solenoid valve (SV) energizes open and bleeds hydraulic fluid (HF) off of a dump valve (DV) causing the DV to open. The open DV allows HF to flow from the MSIV to a small test accumulator. The accumulator is sized so that when it is filled the MSIV is approximately 10% from the fully open position. The HF pressure then builds up and reopens the MSIV. When the MSIV is at the 10% shut position a limit switch operates to deenergize and shut the SV to allow HF pressure to build up on the DV and shut it. After a time delay to allow the MSIV to reopen, a second SV is energized open to bleed HF from a second DV. When this second DV opens the HF in the accumulator is drained to a reservoir. The problem occurred because the first SV stayed opened when it was deenergized, allowing the first DV to remain open. When the MSIV reopened and the second DV opened, both DV's were open, allowing HF from the MSIV actuator to drain directly to the reservior. This caused the MSIV to move rapidly in the closed direction. The same limit switch which deenergized the first SV also deenergizes the second SV if the MSIV goes 10% shut. When the MSIV went 10% shut again, the limit switch operated to shut the second SV which shut the second DV. This prevented all the HF from draining from the actuator, thus preventing the valve from shutting all the way. When the second DV went shut HF pressure built up, reopening the MSIV.

The root cause of this event was determined to be a stuck open SV. Immediately after the MSIV probelm the hydraulic pumps which maintain HF pressure in the system were cycling on and off very rapidly, indicating a system leak. As there was no visible system leak it was concluded a valve must be leaking by internally. All of the signal circuitry tested properly during troubleshooting, so the MSIV was test stroked using closure train A. The first test failed in the same manner as the test which tripped the plant. The MSIV was then tested successfully twice. The hydraulic pumps returned to their normal cycling after the first successful MSIV test. Since the leak went away after a successful test, and a closure stroke of the MSIV requires both DV's to be open simultaneously, it was concluded that the first SV stuck open. The SV being open would cause an internal hydraulic leak and it would also cause the first DV to be open when the second DV opened. The reason for the SV sticking open is suspected to be mechanical malfunctioning or debris caught in the SV's hydraulic orifice. To prevent a possible reoccurrence of the event, the SV was replaced and the replacement was tested successfully per procedure ME-4-809 "Low Voltage (600 Volts and Less) Power and Control Cable/Conductor Terminations and Splices". Procedure OP-903-032 for MSIV #2 was completed successfully at 1636 hours on December 12, 1987. At 1738 hours on December 12, l987, a reactor startup was commenced. The SV and HF sample have been sent to the vendor, Paul-Munroe, for failure analysis and possible system upgrade recommendations. If any

system changes are to be made as a result of the manufacturers evaluation, results of this evaluation will be included in an LER revision.

The only previous problem with the actuators was at 1100 hours on September 27, 1987 with the plant in mode 5 (cold shutdown), when MSIV #1 failed to shut while testing closure train B. The cause was a SV failing to open because of an electrically open coil; therefore, its associated DV was not opened. During a normal MSIV closure both DV's must be opened. This did not affect the ability of closure train A to shut the MSIV and was not a reportable event. This was evaluated as a random failure and does not appear to be related to the present failure.

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During the plant startup, the high pressure governor to MFW Pump Turbine A was unisolated. MFW Pump A and both its high and low pressure governor valves functioned normally throughout the startup and subsequent operations, therefore the high pressure governor has been left unisolated. To prevent main condenser hotwell perturbations from affecting the MFW Pump Turbine DCT's, several design modifications are being studied and are tentatively scheduled to be implemented during the upcoming refueling outage. This is expected to substantially improve the reliability of the MFW system, especially during main condenser hotwell transients.

During the recent event the ability to shut the MSIV was never in question. There are two closure trains for each MSIV and the valve did demonstrate the ability to stroke shut. Since all safety systems functioned as designed, this event did not pose a threat to the health and safety of the public or plant personnel.

SIMILAR EVENTS

NONE

PLANT CONTACT

D.W. Vinci, Maintenance Superintendent, 504/464-3138

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OPERATING POSITION

FIGURE OMITTED - NOT KEYABLE (DRAWING)

ATTACHMENT # 1 TO ANO # 8801200424 PAGE: 1 of 1

Ref: 10CFR50.73(a)(2)(iv)

LOUISIANA
POWER & LIGHT Waterford 3 SES . P.O.Box B . Killona, LA 70066
Middle South
Utilities System
January 11, l988

W3A88-0013
A4.05
QA

U.S. Nuclear Regulatory Commission
ATTENTION: Document Control Desk
Washington, D.C. 20555

SUBJECT: Waterford 3 SES
Docket No. 50-382
License No. NPF-38
Reporting of Licensee Event Report

Attached is Licensee Event Report Number LER-87-028-00 for Waterford Steam Electric Station Unit 3. This report is submitted pursuant to 10CFR50.73(a)(2)(iv).

Very truly yours,
/s/ N. S. Carns
N.S. Carns
Plant Manager - Nuclear

NSC/WMC:rk
Attachment

cc: R.D. Martin, NRC Resident Inspectors Office - INPO Records Center
(J.T. Wheelock), E.L. Blake, W.M. Stevenson, J.H. Wilson

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